

2023-2042 System & Resource Outlook Update

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Electric System Planning Working Group (ESPWG)

March 1, 2024, NYISO

Reposted March 4, 2024

Agenda

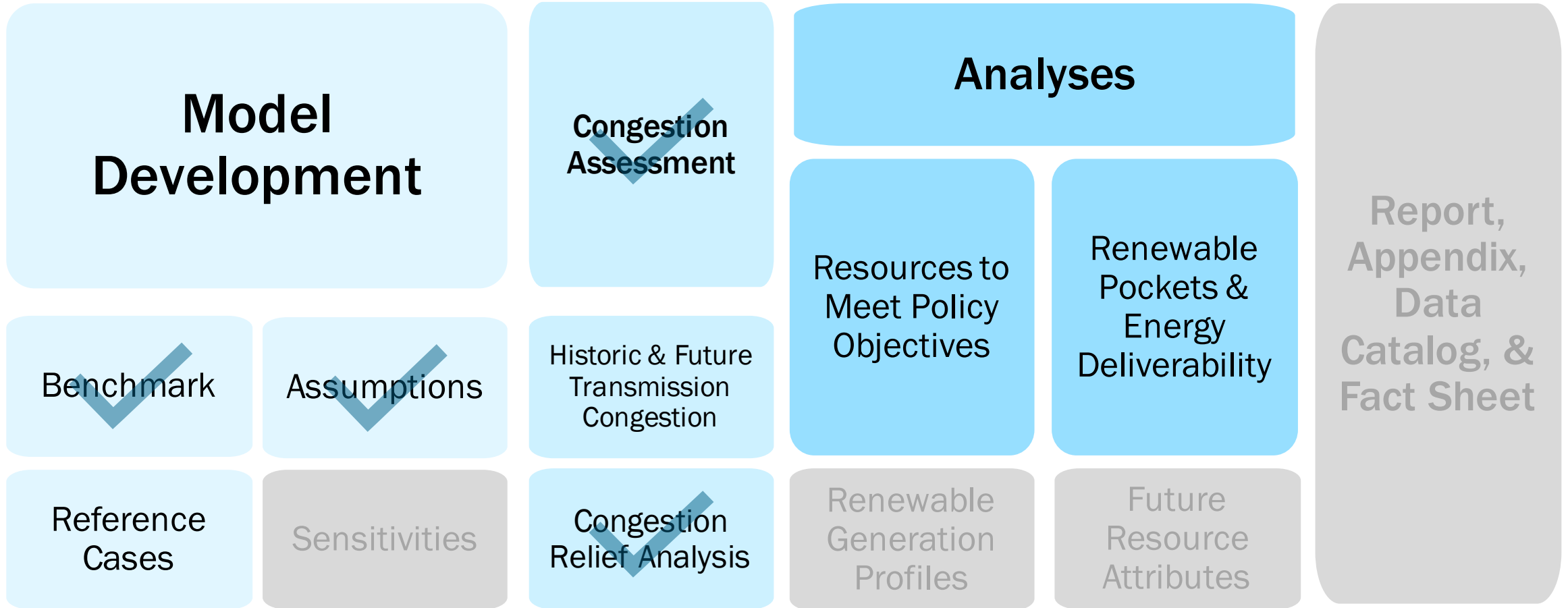
- **Scope & Schedule Review**
- **Reference Case Updates**
 - Contract Case
 - Policy Case
- **Next Steps**
- **Outlook Data Catalog**
- **Appendix**

Supplemental Material Posted

- In addition to today's presentation, an excel spreadsheet with final Base Case results has been posted with today's meeting materials
- This spreadsheet will be updated accordingly to include final Contract and Policy Case results throughout the System & Resource Outlook process

Scope & Schedule Review

System & Resource Outlook Scope



Preliminary Targeted Study Schedule

2024 Q1	Month	January					February				March			
	Week	1	2	3	4	5	1	2	3	4	1	2	3	4
	Benchmarking													
	Assumptions Development													
	Capacity Expansion Model Development	X	X	X	X	X	X	X	X	X				
	Capacity Expansion Results & Analyses						X	X	X	X	X	X	X	X
2024 Q2	Production Cost Model Development	X	X	X	X	X	X	X	X	X	X	X	X	X
	Production Cost Results & Analyses	X	X	X	X	X	X	X	X	X	X	X	X	X
2024 Q2	Month	April					May				June			
	Week	1	2	3	4	5	1	2	3	4	1	2	3	4
	Capacity Expansion Model Development													
	Capacity Expansion Results & Analyses													
	Production Cost Model Development													
	Production Cost Results & Analyses	X	X	X	X	X								
2024 Q2	Sensitivities	X	X	X	X	X								
	Report	X	X	X	X	X	X	X	X	X	X	X	X	X

Contract Case

Contract Case: Updates

- Continue to evaluate renewable pocket analyses
- See here for 2021-2040 renewable pocket analysis: [link](#)

The Outlook Renewable Generation Pocket Process

- Pocket definitions kept consistent with those identified in 2021-2040 System and Resource Outlook study
- Renewable generation pockets are presented for year 2030 for the Contract Case and will also be evaluated for Policy cases
- A pocket is formed by local transmission congestion (if transmission lines are congested for more than 100 hours) causing bottlenecks for renewable generation
- Pocket metrics (e.g., curtailment, number of congested hours, energy deliverability, etc.) will be reported

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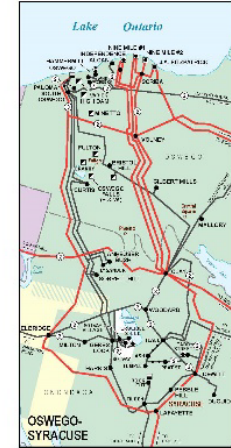
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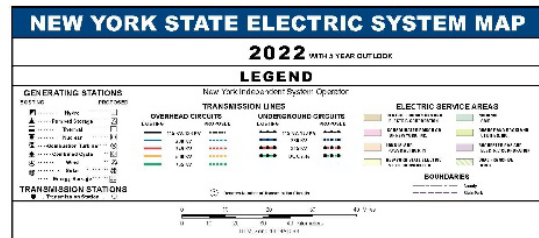
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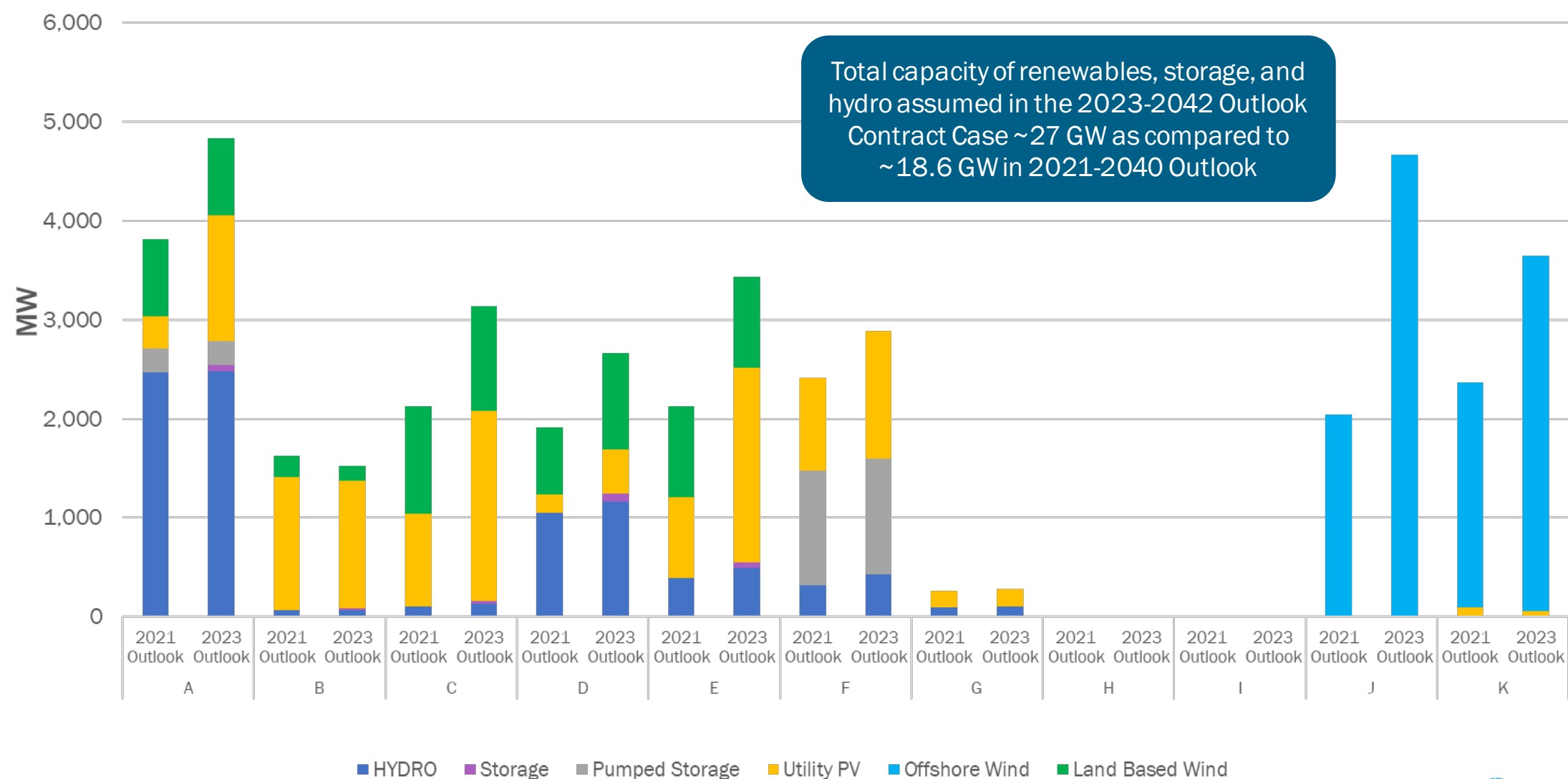
Key	Cont.	S1
Wind		
Solar		



Key Considerations

- **Contract Case includes the approved Phase 1 and 2 transmission upgrades and NYPA's Smart Path Project**
- **Hydro resource model changes reflect limited pondage capability of most hydro units in New York, except Niagara units**
- **The scale of renewable resource capacity has increased (45%) as compared to the prior Contract Case in the 2021-2040 System and Resource Outlook**

Contract Case Installed Capacity (2030)



*HYDRO capacity difference due to update in DMNC for existing hydro units consistent with 2023 Gold Book.

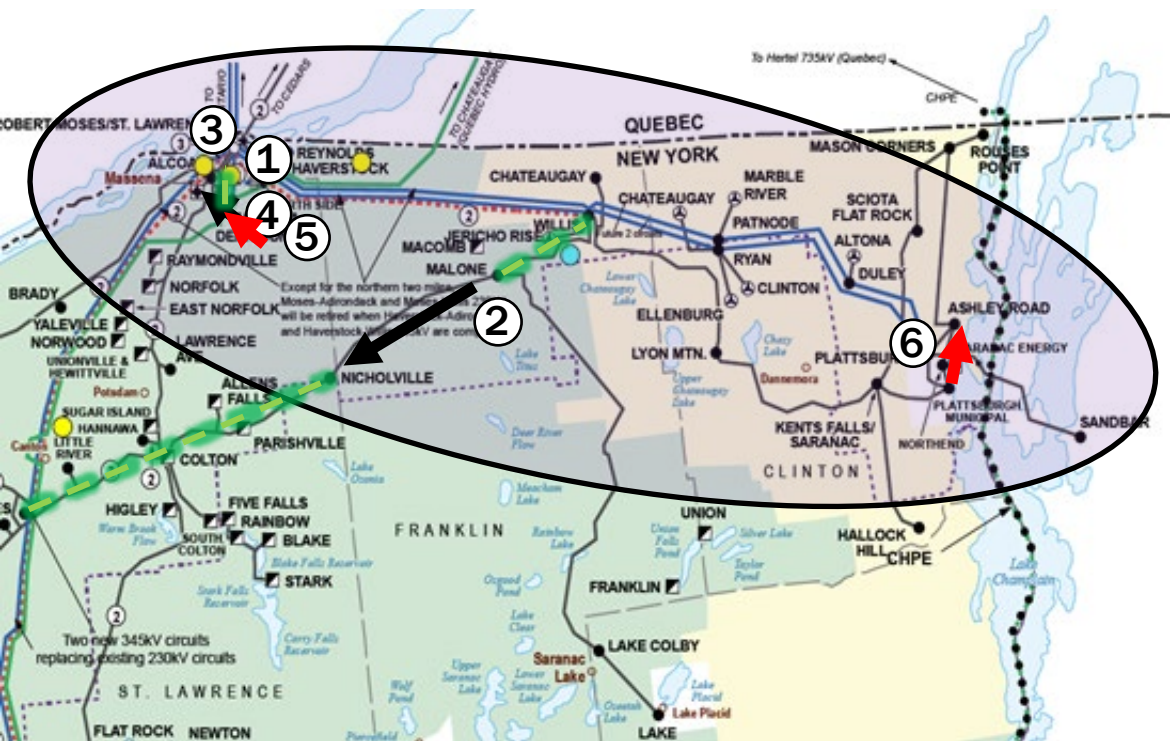
Pocket X1

North Country: Northern Area

Black arrows represent lines congested in the current 2023-2042 Outlook and/or prior 2021-2040 Outlook Contract Case that meets the 100 congested hours criteria

Red arrows and numbers represent lines only congested in the 2021-2040 Outlook Contract Case

Green highlights represent Phase 1 and 2 transmission upgrades



ID	Constraint	Number of Limiting Hours	
		2023 Outlook Contract Case	2021 Outlook Contract Case
1	North Tie OH-NY	6,602	7,678
2	MALONE 115.00-NICHOLVL 115.00	2,399	-
3	MOSES W 230.00-MNH3230 230.00	1,854	-
4	ALCOA-NM 115.00-ALCOA N 115.00	182	926
5	ALCOA-NM 115-DENNISON 115	22	782
6	NOEND115 115-PLAT 115 115	-	128

Type	Capacity (MW)		Energy Deliverability (%)	
	2023 Outlook Contract Case	2021 Outlook Contract Case	2023 Outlook Contract Case	2021 Outlook Contract Case
Hydro	1155	1049	98%	100%
Wind	977	876	94%	100%
Solar	690	180	91%	100%

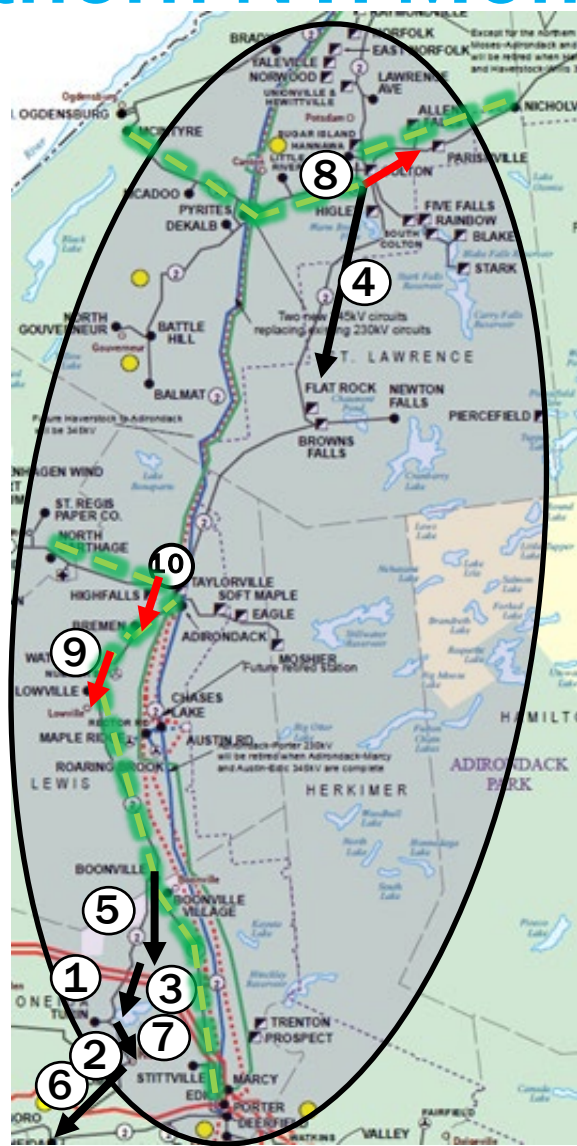
Pocket X2

Northern NY: Mohawk Valley Area

Black arrows represent lines congested in the current 2023-2042 Outlook and/or prior 2021-2040 Outlook Contract Case that meets the 100 congested hours criteria

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Green highlights represent Phase 1 and 2 transmission upgrades



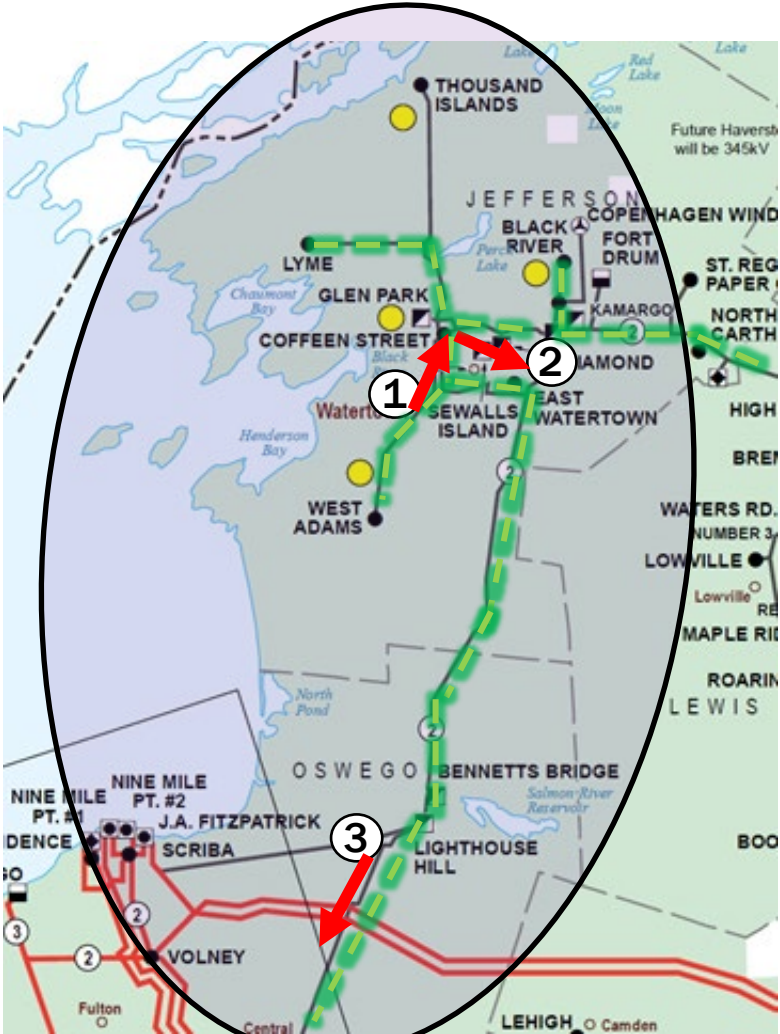
ID	Constraint	Number of Limiting Hours	
		2023 Outlook Contract Case	2021 Outlook Contract Case
1	AVA-USAF 115.00-TURIN 115.00	6,275	-
2	TRNG STN 115.00-ROME 115.00	6,091	-
3	BVPAR-4 115.00-GRIFFISS 115.00	1,010	-
4	COLTON 115.00-FLAT RCK 115.00	962	-
5	AVA-USAF 115.00-BVPAR-3 115.00	917	-
6	TRNG STN 115.00-STERLING 115.00	349	-
7	MADISON 115.00-ROME 115.00	278	-
8	NICHOLVL 115-PARISHVL 115	-	515
9	LOWVILLE 115-Q531_POI 115	-	434
10	BREMEN 115-Q531_POI 115	-	182

Type	Capacity (MW)		Energy Deliverability (%)	
	2023 Outlook Contract Case	2021 Outlook Contract Case	2023 Outlook Contract Case	2021 Outlook Contract Case
Hydro	252	250	97%	100%
Wind	505	505	96%	100%
Solar	80	35	94%	96%

New York ISO

Pocket X3

Northern NY: Ontario Area



Black arrows represent lines congested in the current 2023-2042 Outlook and/or prior 2021-2040 Outlook Contract Case that meets the 100 congested hours criteria

Red arrows and numbers represent lines only congested in the 2021-2040 Outlook Contract Case

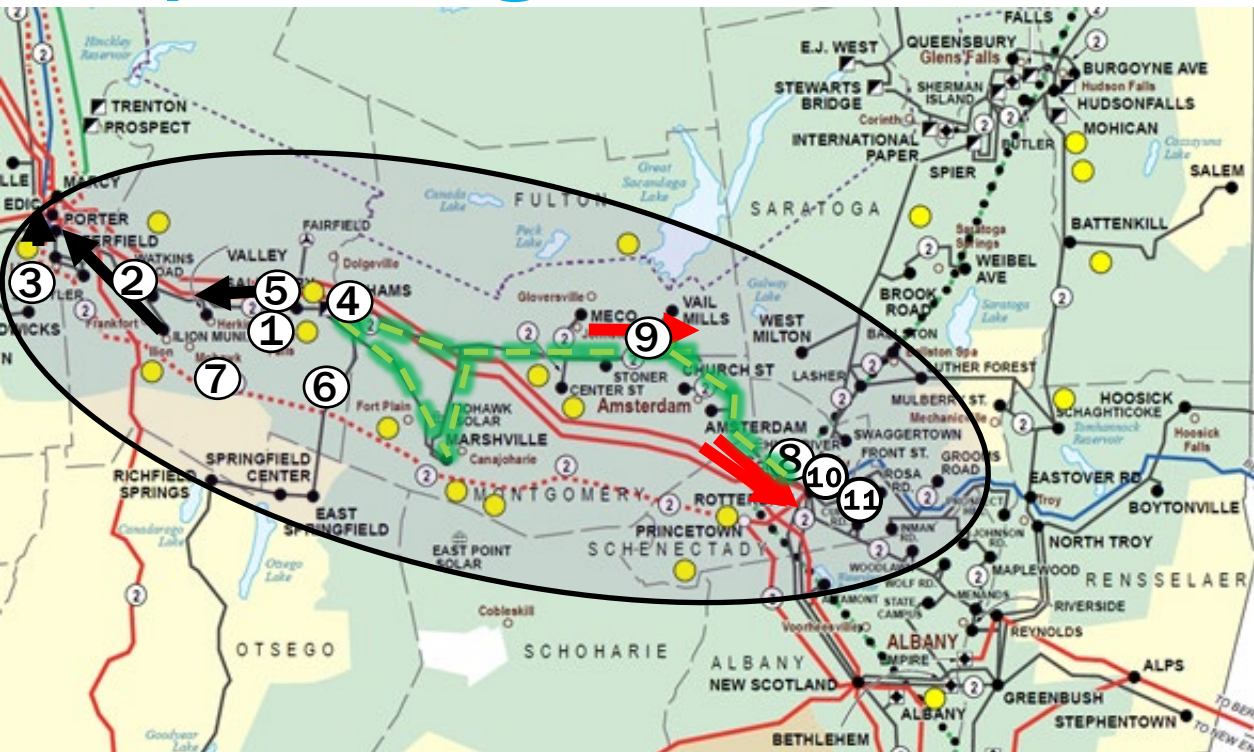
Green highlights represent Phase 1 and 2 transmission upgrades

ID	Constraint	Number of Limiting Hours	
		2023 Outlook Contract Case	2021 Outlook Contract Case
1	COFFEEN 115-GLEN PRK 115	-	1,119
2	COFFEEN 115-E WTRTWN 115	-	748
3	HTHSE HL 115-MALLORY 115	-	591

Type	Capacity (MW)		Energy Deliverability (%)	
	2023 Outlook Contract Case	2021 Outlook Contract Case	2023 Outlook Contract Case	2021 Outlook Contract Case
Hydro	224	155	98%	99%
Wind	80	80	98%	100%
Solar	469	369	99%	90%

Pocket Y1

Capital Region: Mohawk Valley Area



Type	Capacity (MW)		Energy Deliverability (%)	
	2023 Outlook Contract Case	2021 Outlook Contract Case	2023 Outlook Contract Case	2021 Outlook Contract Case
Hydro	32	30	94%	100%
Wind	74	74	90%	97%
Solar	1,700	961	94%	96%

ID	Constraint	Number of Limiting Hours	
		2023 Outlook Contract Case	2021 Outlook Contract Case
1	FRFLD A 115.00-VALLEY 115.00	3,848	-
2	PORTER 1 115.00-ILION 115.00	1,233	-
3	DEERFD-H 115.00-PORTER 1 115.00	946	-
4	INGMS-CD 115.00-INGHAM-E 115.00	589	-
5	INGMS-CD 115.00-SALBRY4 115.00	273	-
6	INGMS-CD 115.00-SALBRY3 115.00	185	-
7	Q581_POI 115.00-SALBRY4 115.00	166	-
8	RTRDM1 115-Q638POI 115	-	1,200
9	STONER 115-VAIL TAP 115	-	882
10	AMST 115 115-Q638POI 115	-	302
11	Q638POI 115-AMST 115 115	-	293

Black arrows represent lines congested in the current 2023-2042 Outlook and/or prior 2021-2040 Outlook Contract Case that meets the 100 congested hours criteria

Red arrows and numbers represent lines only congested in the 2021-2040 Outlook Contract Case

Green highlights represent Phase 1 and 2 transmission upgrades

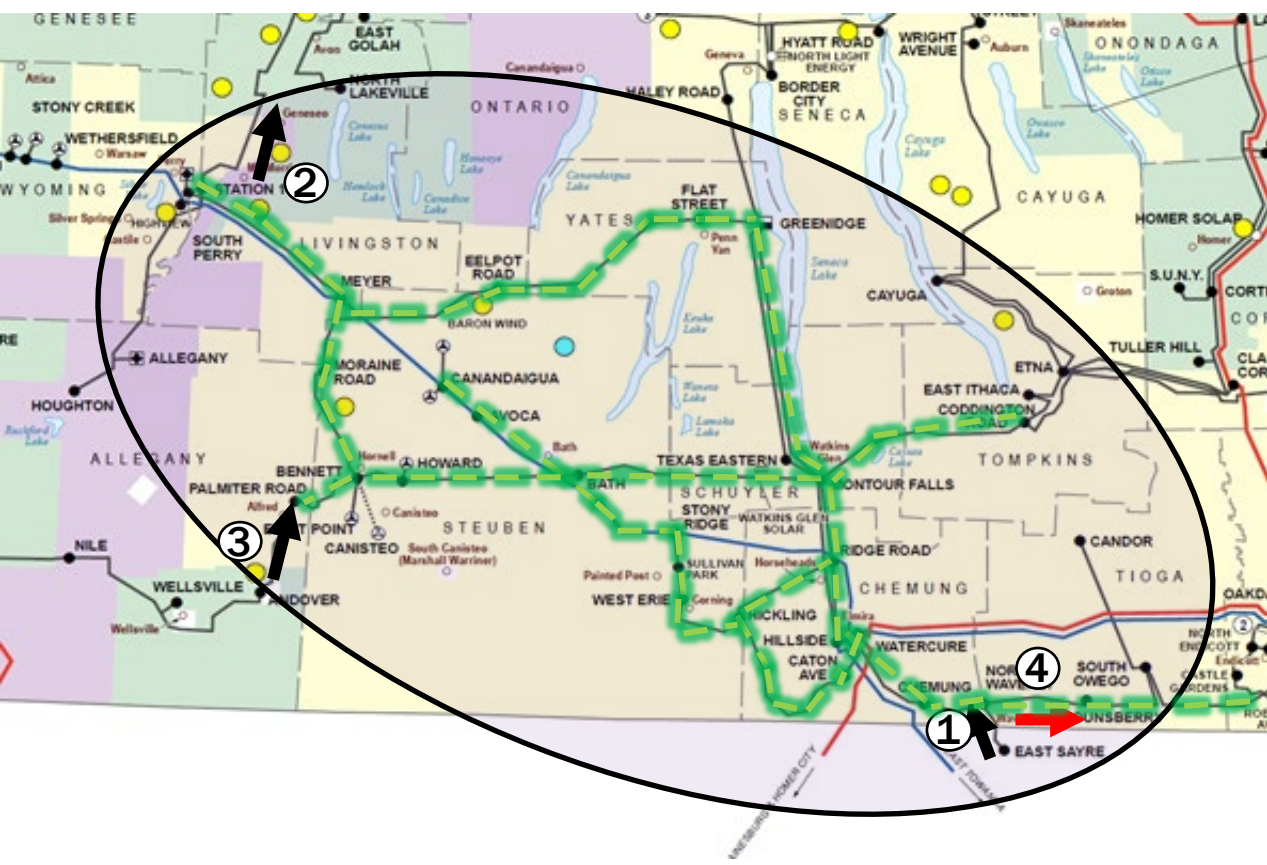
Pocket Z1

Southern Tier: Finger Lakes Area

Black arrows represent lines congested in the current 2023-2042 Outlook and/or prior 2021-2040 Outlook Contract Case that meets the 100 congested hours criteria

Red arrows and numbers represent lines only congested in the 2021-2040 Outlook Contract Case

Green highlights represent Phase 1 and 2 transmission upgrades





ID	Constraint	Number of Limiting Hours	
		2023 Outlook Contract Case	2021 Outlook Contract Case
1	N.WAV115 115.00-26E.SAYR 115.00	4,186	3,225
2	S.PER115 115.00-STA 158S 115.00	1,030	-
3	PALMT115 115.00-ANDOVER1 115.00	252	-
4	LOUNS115 115-STAGECOA 115	-	170


Type	Capacity (MW)		Energy Deliverability (%)	
	2023 Outlook Contract Case	2021 Outlook Contract Case	2023 Outlook Contract Case	2021 Outlook Contract Case
Wind	691	720	100%	100%
Solar	927	405	99%	100%

Pocket Z2

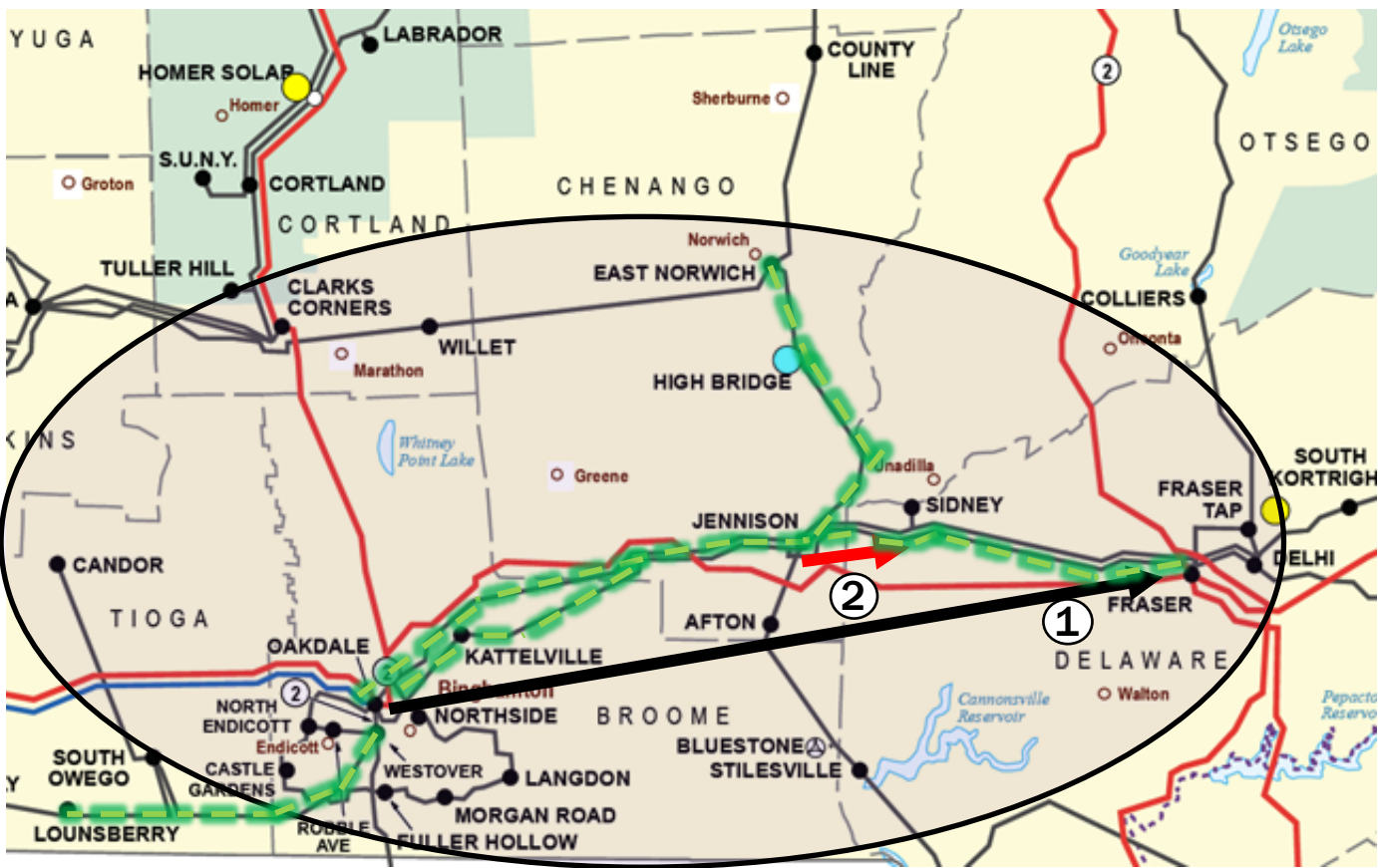
Southern Tier: Binghamton Area

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Black arrows represent lines congested in the current 2023-2042 Outlook and/or prior 2021-2040 Outlook Contract Case that meets the 100 congested hours criteria
- 

Red arrows and numbers represent lines only congested in the 2021-2040 Outlook Contract Case
- 

Green highlights represent Phase 1 and 2 transmission upgrades



ID	Constraint	Number of Limiting Hours	
		2023 Outlook Contract Case	2021 Outlook Contract Case
1	FRASR345 345.00-OAKDL345 345.00	230	-
2	JENN 115 115-SIDNT115 115	-	542

Type	Capacity (MW)		Energy Deliverability (%)	
	2023 Outlook Contract Case	2021 Outlook Contract Case	2023 Outlook Contract Case	2021 Outlook Contract Case
Wind	213	213	100%	99%
Solar	205	60	97%	100%

Key Findings

- Phase 1 and 2 transmission upgrade projects address much of the congestion identified in the previous pocket analysis.
- Some pockets exhibit low to no congestion on the lower kV transmission lines.
- With increased renewable energy capacity and modeling changes to hydro resources in the 2023-2042 Outlook Contract Case, some pockets show increased curtailment of resources due to increased competition and decreased flexibility.
- Congestion downstream of upgraded paths are observed to be the next limiting elements in most pockets.
- Some curtailment can be attributed to congestion on the bulk system, especially the resources directly connected to higher kV buses or that are close to the bulk system.
 - Increase in congestion on the bulk system can be seen on the “Projected NYCA-Wide Demand Congestion by Constraint” charts for the Base and Contract Case results [here](#).

Policy Case

Capacity Expansion Model Assumptions: Overview

- **The Policy Case for the 2023-2042 Outlook will include three main scenarios**
 - Lower Demand Policy Case, Higher Demand Policy Case, State Scenario
- **The three scenarios have a similar model framework (e.g., study years, time representation methodology, transmission network, etc.)**
- **Each scenario has a unique energy forecast to represent a variety of potential future conditions**
 - E.g., annual energy, peak demand, large loads, BTM solar forecasts
- **Detailed assumptions for these three scenarios are included in the capacity expansion model assumptions matrix**

Capacity Expansion Model Enhancements: Overview

- **In addition to many assumptions that have been updated since the 2021-2040 Outlook, several enhancements have been incorporated into the capacity expansion model for each of the three Policy Cases in the 2023-2042 Outlook as presented at previous ESPWG meetings**
 - Changed methodology for time representation
 - Addition of external pools
 - Addition of generation supply curves for renewable technologies
 - Addition of 8-hour battery storage as candidate for expansion
 - Updated marginal ELCC curves (specific to each scenario)
- **Additionally, the following enhancements will be incorporated into the State Scenario:**
 - Hydrogen repowered units are candidates for expansion, including electrolysis load
 - Sub-zonal constraints modeled to reflect estimated transmission headroom of local transmission & distribution system and conceptual marginal upgrade costs

Key Considerations

- **Methodology for time representation has a major impact on model results**
 - Preserving chronology within each day allows for a more accurate representation of battery storage resources as it tracks state-of-charge and duration limited qualities intraday
 - Preliminary results show a higher need for dispatchable resources to satisfy energy needs as compared to the prior Outlook
- **The capacity expansion model has been updated to include neighboring systems (PJM, ISO-NE, and IESO)**
 - External load and capacity/generation mix has been informed by public information for each respective neighboring system to reflect “policy futures” in each region
 - Preliminary results show interchange between the regions to optimally dispatch generation
- **The marginal ELCC curves for renewable and battery storage resources are unique to each scenario based on the respective resource penetration in each scenario**

Capacity Expansion Model: Time Representation

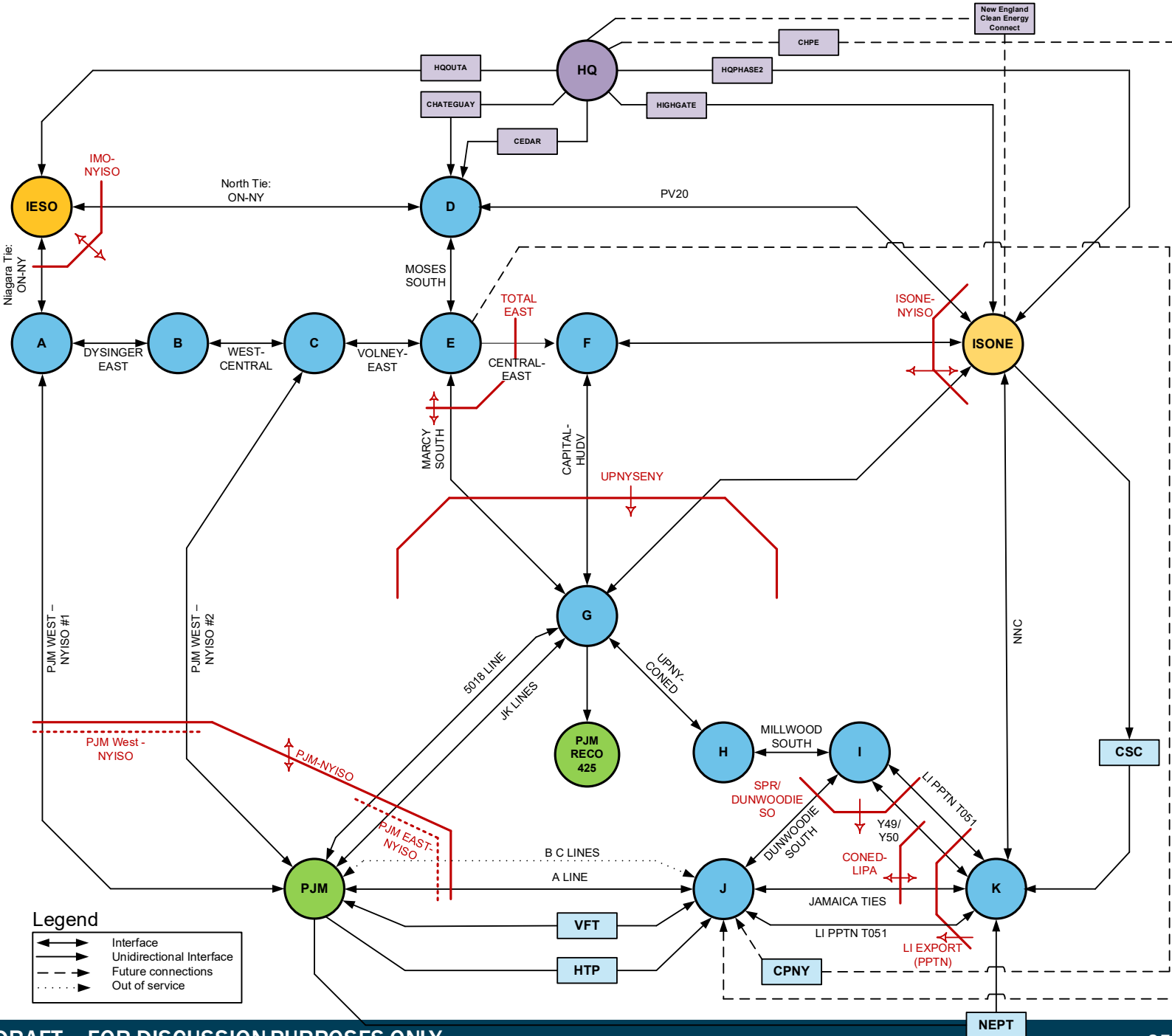
- For the 2023-2042 Outlook, model each year with 13 representative days to represent a year's variety of conditions
- For each model year, base representative days on load, wind (OSW and LBW), and solar values
- Seek to preserve annual energy total, seasonal peaks, and variable performance of renewable resources
- Each year will include the following representative days (totaling 13 per year) with six 4-hour periods per day:
 - Peak summer day (weighted 1x)
 - Peak winter day (weighted 1x)
 - Near peak summer day (weighted 5x)
 - Near peak winter day (weighted 5x)
 - Moderate day (weighted based on clustering)
 - 8 groups to represent each combination of high/low energy, wind, and solar
- Additional detail on the time representation proposal for the 2023-2042 Outlook is included in the November 2, 2023 ESPWG materials

Capacity Expansion

Model: Pipe & Bubble Representation

Interface	2023 Limits (MW)	Source
Dysinger East	1700	2020 ATR
West Central	575	2020 ATR
Moses South*	2325	2020 ATR
Central East	3785	2023 Central East Voltage Limit Study
Total East	6175	2020 ATR
UPNY-SENY	6325	2020 ATR
UPNY-ConEd*	7500	2020 ATR
Clean Path New York	1300	NYSERDA Contract
Champlain Hudson Power Express	1250	NYSERDA Contract

*Interface limits are assumed to increase through study period consistent with proposed project upgrades



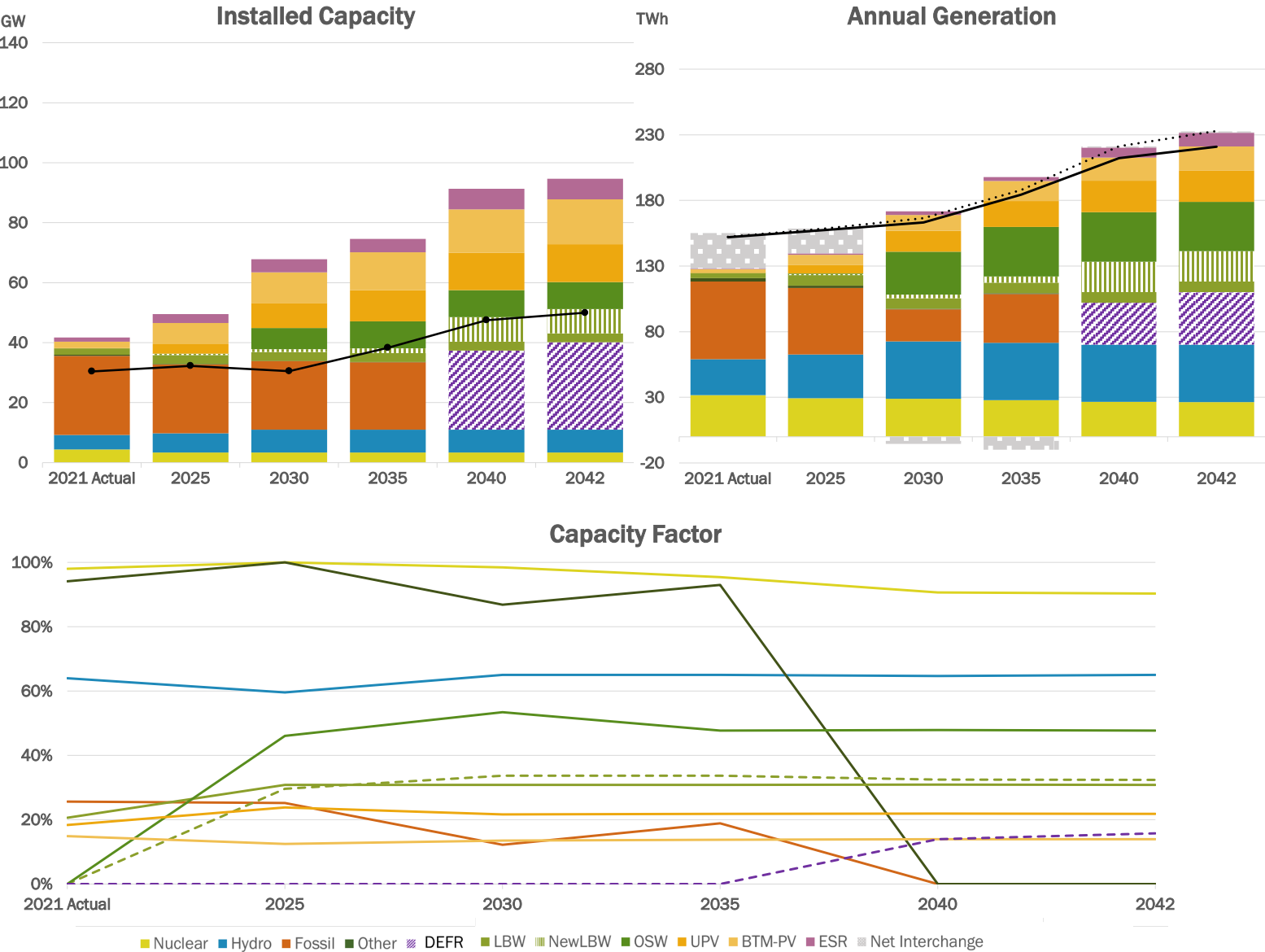
Capacity Expansion Enhancements: Marginal ELCC Curves

- **For all Policy Case scenarios in the 2023-2042 Outlook, marginal ELCC curves will be assumed for LBW, OSW, UPV, and ESR resources**
 - Updated regional ELCC curves for LBW, OSW, UPV, and storage would be based on hourly input load forecast and resource contribution (by technology type) to quantify the capacity value for that resource type at varying levels of installed capacity
 - This method will base the marginal ELCC values on the load levels and capacity mix specific to each scenario for 2030 model year
- **Marginal ELCC curves will be applied on a NYCA wide and Locality specific basis, as applicable to the resource**
 - “Lower Demand Policy” and “Higher Demand Policy” Scenarios will assume unique curves for summer/winter seasons
 - “State Scenario” will assume annual curves consistent with the Integration Analysis
- **Additional detail on the marginal ELCC value representation proposal for the 2023-2042 Outlook is included in the October 24, 2023 ESPWG materials**

Preliminary Results & Key Findings

- **Preliminary results for the Lower Demand Policy Case and Higher Demand Policy Case scenarios are included on the following slides**
 - Preliminary results for the State Scenario will be presented at an upcoming ESPWG following completion of the model development for this scenario to include all proposed enhancements
- **The primary drivers of the resource mix for each scenario are:**
 - Load forecast (i.e., total energy & peak forecasts)
 - Time representation (e.g., chronology preserved)
 - Assumed policy mandates
- **Preliminary findings indicate that a minimum of 65 GW of new resources would be required by 2040 to achieve policy mandates**
 - This includes firm builds (i.e., awarded resources) and generators selected by capacity expansion model throughout the study period
- **Dispatchable emission free resources generate in model years 2040 and beyond to support energy needs**

Preliminary Results: Lower Demand Policy Case



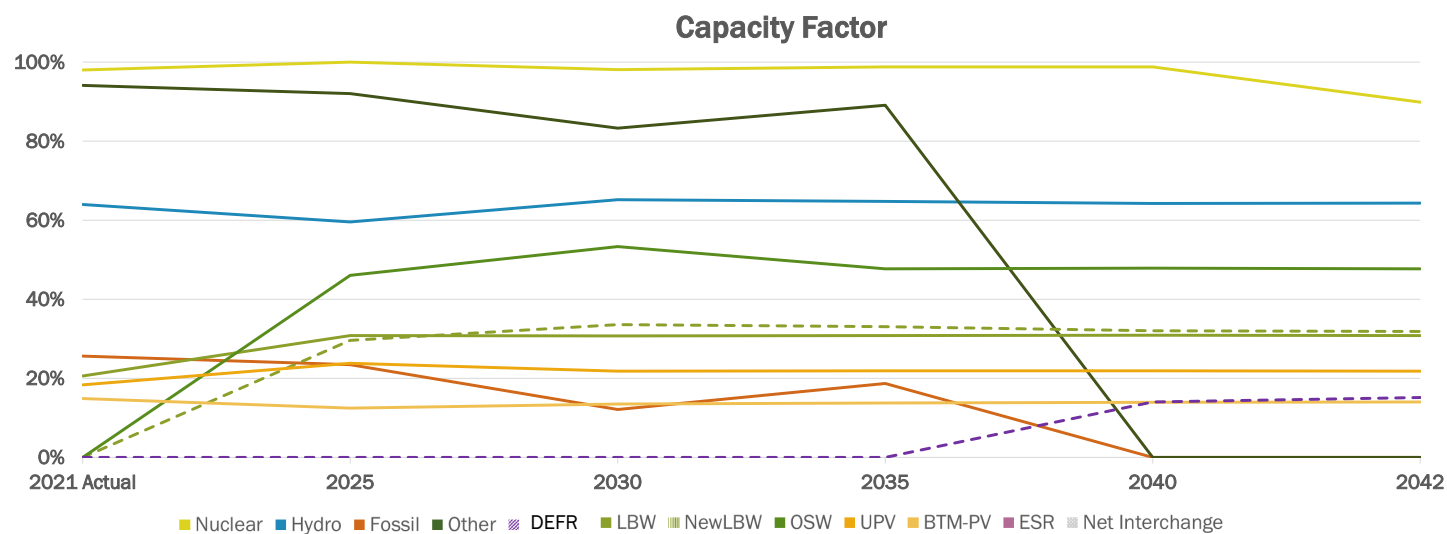
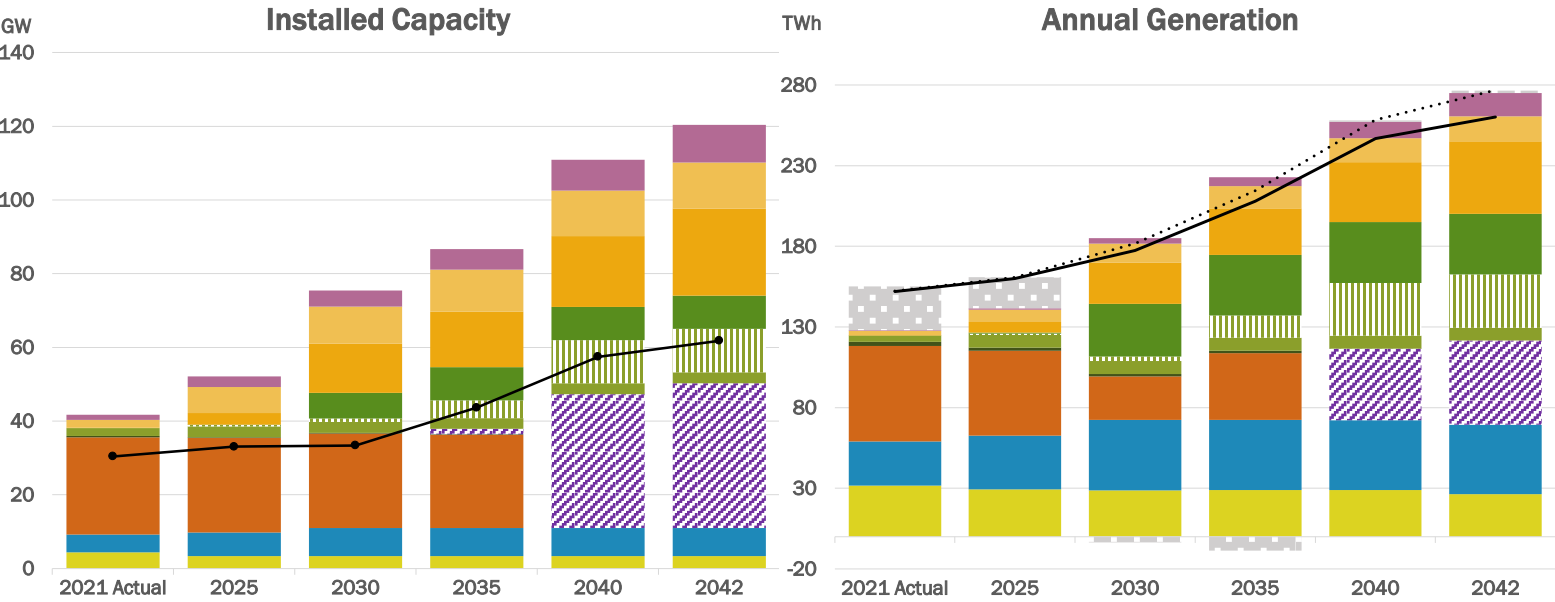
Capacity (Summer MW)						
	2021	2025	2030	2035	2040	2042
Nuclear	4,378	3,342	3,342	3,342	3,342	3,342
Fossil	26,345	23,007	22,867	22,461	-	-
DEFR - HcLo	-	-	-	-	4,114	4,331
DEFR - McMo	-	-	-	-	-	-
DEFR - LcHo	-	-	-	-	22,239	24,792
Hydro	4,868	6,381	7,665	7,665	7,665	7,665
LBW	2,227	3,291	3,881	4,570	11,095	11,095
OSW	-	136	6,990	9,000	9,000	9,000
UPV	32	3,135	8,422	10,381	12,499	12,572
BTM-PV	2,116	7,097	10,153	12,644	14,444	14,988
Storage	1,405	2,905	4,405	4,405	6,892	6,892
Total	41,686	49,490	67,805	74,548	91,290	94,677

Generation (GWh)						
	2021	2025	2030	2035	2040	2042
Nuclear	31,609	29,276	28,831	27,940	26,552	26,438
Fossil	59,154	50,788	24,400	37,089	-	-
DEFR - HcLo	-	-	-	-	29,034	35,114
DEFR - McMo	-	-	-	-	-	-
DEFR - LcHo	-	-	-	-	3,117	5,012
Hydro	27,379	33,281	43,688	43,687	43,455	43,686
LBW	4,024	8,841	10,700	12,738	31,162	31,048
OSW	-	549	32,708	37,607	37,758	37,601
UPV	51	6,528	15,991	19,843	23,942	24,016
BTM-PV	2,761	7,718	12,024	15,232	17,582	18,311
Storage	355	1,009	2,722	2,963	7,782	10,317
Total Generation	127,930	139,712	171,669	197,750	220,383	231,543
RE Generation	34,215	56,917	115,110	129,107	153,898	154,662
ZE Generation	65,824	86,192	143,941	157,047	212,602	221,226
Load	151,979	157,528	163,222	184,439	212,121	220,946
Load+Charge	152,334	158,684	166,426	188,001	221,339	232,956
% RE [RE/Load]	23%	36%	71%	70%	73%	70%
% ZE [ZE/(Load+Charge)]	43%	55%	88%	85%	100%	100%

Emissions (million tons)						
	2021	2025	2030	2035	2040	2042
CO ₂ Emissions	22.24	21.47	10.21	15.72	-	-

* Storage includes Pumped Storage Hydro and Batteries
* Utility solar (UPV) includes existing and new UPV
* Hydro includes hydro imports from Hydro Quebec
* Land-Based Wind (LBW), Offshore Wind (OSW), Renewable (RE), Zero Emissions (ZE)
* Dispatchable Emission Free Resource (DEFR), High Capital Low Operating (HcLo), Medium Capital Medium Operating (McMo), Low Capital High Operating (LcHo)

Preliminary Results: Higher Demand Policy Case



Capacity (Summer MW)						
	2021	2025	2030	2035	2040	2042
Nuclear	4,378	3,342	3,342	3,342	3,342	3,342
Fossil	26,345	25,639	25,639	25,233	-	-
DEFR - HcLo	-	-	-	-	6,495	7,133
DEFR - McMo	-	-	-	-	-	-
DEFR - LcHo	-	-	-	1,421	29,771	32,123
Hydro	4,868	6,381	7,631	7,665	7,665	7,665
LBW	2,227	3,291	3,881	7,712	14,653	14,750
OSW	-	136	6,990	9,000	9,000	9,000
UPV	32	3,135	13,313	15,089	19,289	23,575
BTM-PV	2,116	7,097	10,032	11,420	12,308	12,567
Storage	1,405	2,905	4,405	5,598	8,341	10,211
Total	41,686	52,155	75,437	86,685	110,863	120,366

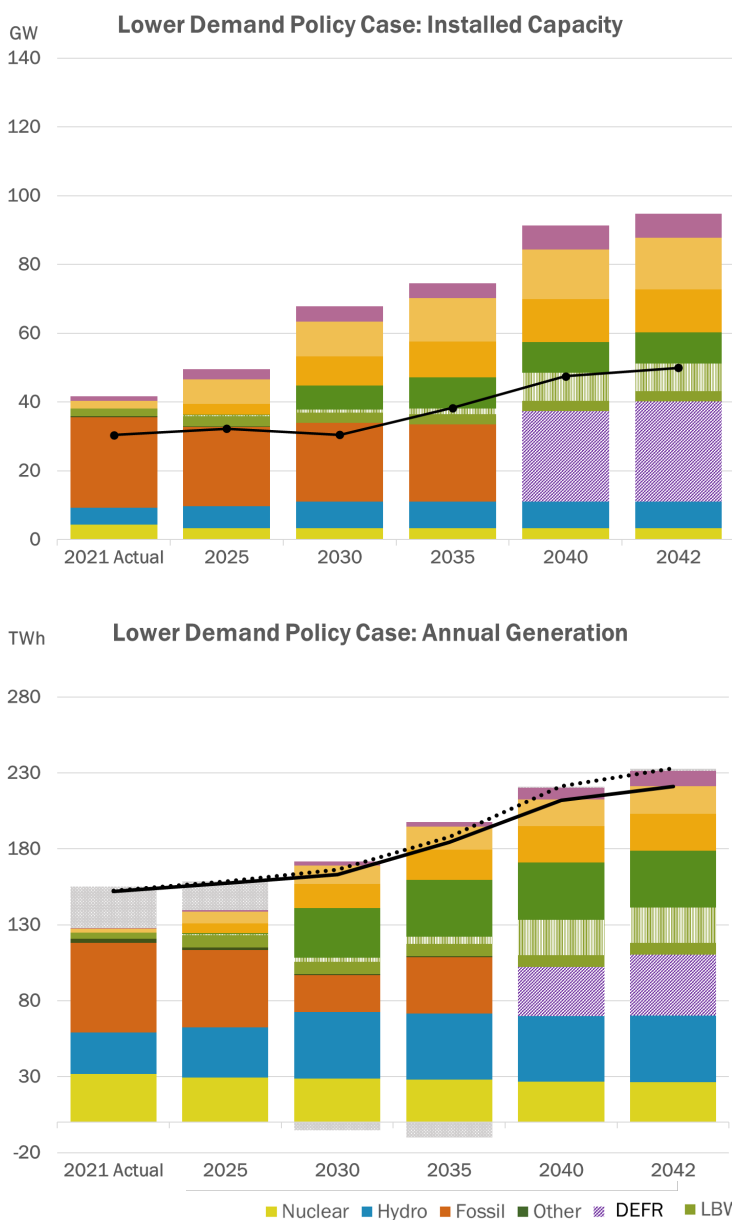
Generation (GWh)						
	2021	2025	2030	2035	2040	2042
Nuclear	31,609	29,276	28,723	28,938	28,931	26,326
Fossil	59,154	52,701	27,101	41,297	-	-
DEFR - HcLo	-	-	-	-	40,206	46,297
DEFR - McMo	-	-	-	-	-	-
DEFR - LcHo	-	-	-	-	4,242	5,779
Hydro	27,379	33,282	43,606	43,514	43,161	43,189
LBW	4,024	8,837	10,694	21,737	40,824	40,913
OSW	-	548	32,661	37,608	37,752	37,602
UPV	51	6,529	25,422	28,908	36,981	45,060
BTM-PV	2,761	7,720	11,880	13,774	15,022	15,399
Storage	355	746	3,425	5,516	10,082	14,453
Total Generation	127,930	141,496	185,003	222,888	257,202	275,018
RE Generation	34,215	56,916	124,264	145,541	173,741	182,163
ZE Generation	65,824	86,192	152,987	174,479	247,120	260,565
Load	151,979	159,991	177,520	207,916	246,751	260,233
Load+Charge	152,334	160,842	181,704	214,449	258,444	276,767
% RE [RE/Load]	23%	36%	70%	70%	70%	70%
% ZE [ZE/(Load+Charge)]	43%	54%	86%	84%	100%	100%

Emissions (million tons)						
	2021	2025	2030	2035	2040	2042
CO ₂ Emissions	22.24	22.38	11.41	17.68	-	-

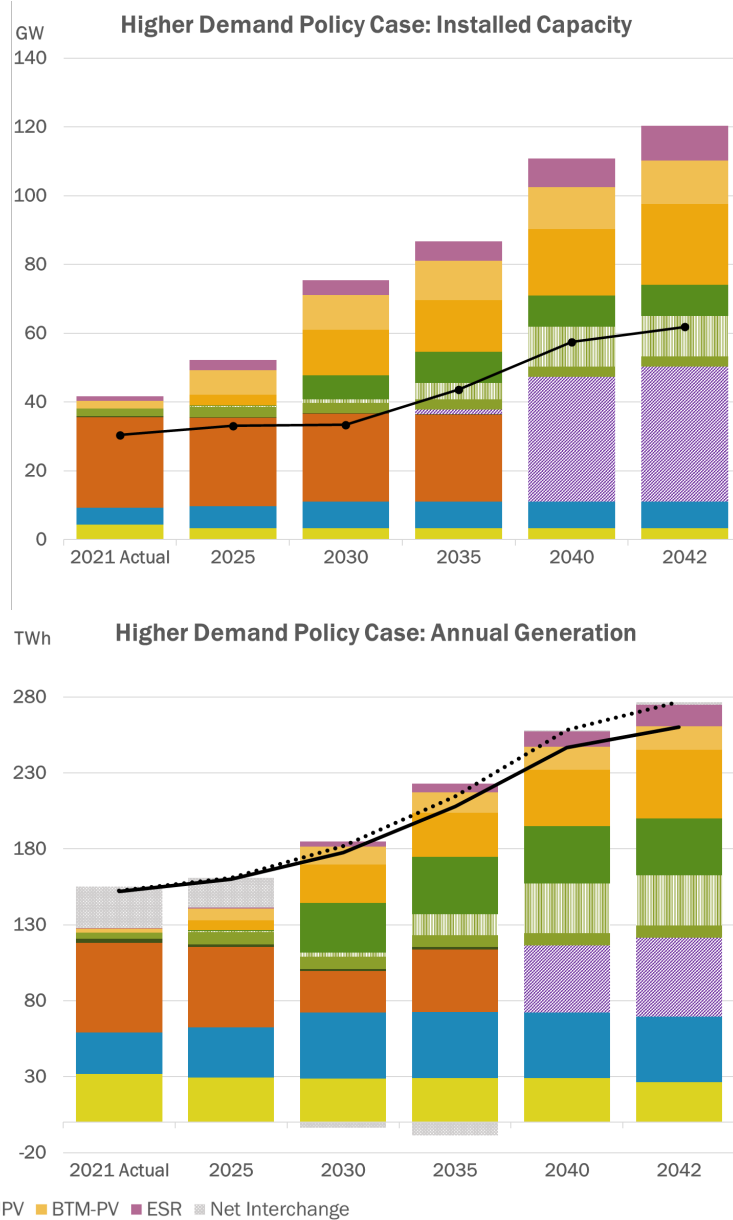
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* Hydro includes hydro imports from Hydro Quebec
* Land-Based Wind (LBW), Offshore Wind (OSW), Renewable (RE), Zero Emissions (ZE)
* Dispatchable Emission Free Resource (DEFR), High Capital Low Operating (HcLo), Medium Capital Medium Operating (McMo), Low Capital High Operating (LcHo)

Preliminary Results Comparison

Preliminary: Lower Demand Policy Case



Preliminary: Higher Demand Policy Case



Policy Case: Next Steps

- **Seek stakeholder feedback on preliminary results for capacity expansion scenarios**
- **Finalize model development of the State Scenario**
- **Continue production cost model development for Policy Case scenarios**
- **Return to ESPWG with results for all three capacity expansion scenarios**

Next Steps

Next Steps

- **Seek stakeholder feedback**
- **Continue to evaluate renewable pockets analyses**
- **Finalize model development of the State Scenario in the capacity expansion model**
- **Continue model development of Policy Case scenarios in the production cost model**
- **Continue stakeholder engagement**
 - Next presentation: March 21, 2024 ESPWG

Questions, Comments, & Feedback?

Email additional feedback to:
SCarkner@nyiso.com
one week prior the next ESPWG

2023-2042 System & Resource Outlook Data Catalog

Report



Report Appendices

Production Cost Model Benchmark DRAFT
Production Cost Assumptions Matrix DRAFT
Capacity Expansion Assumptions Matrix DRAFT

Study Summary



Data Documents

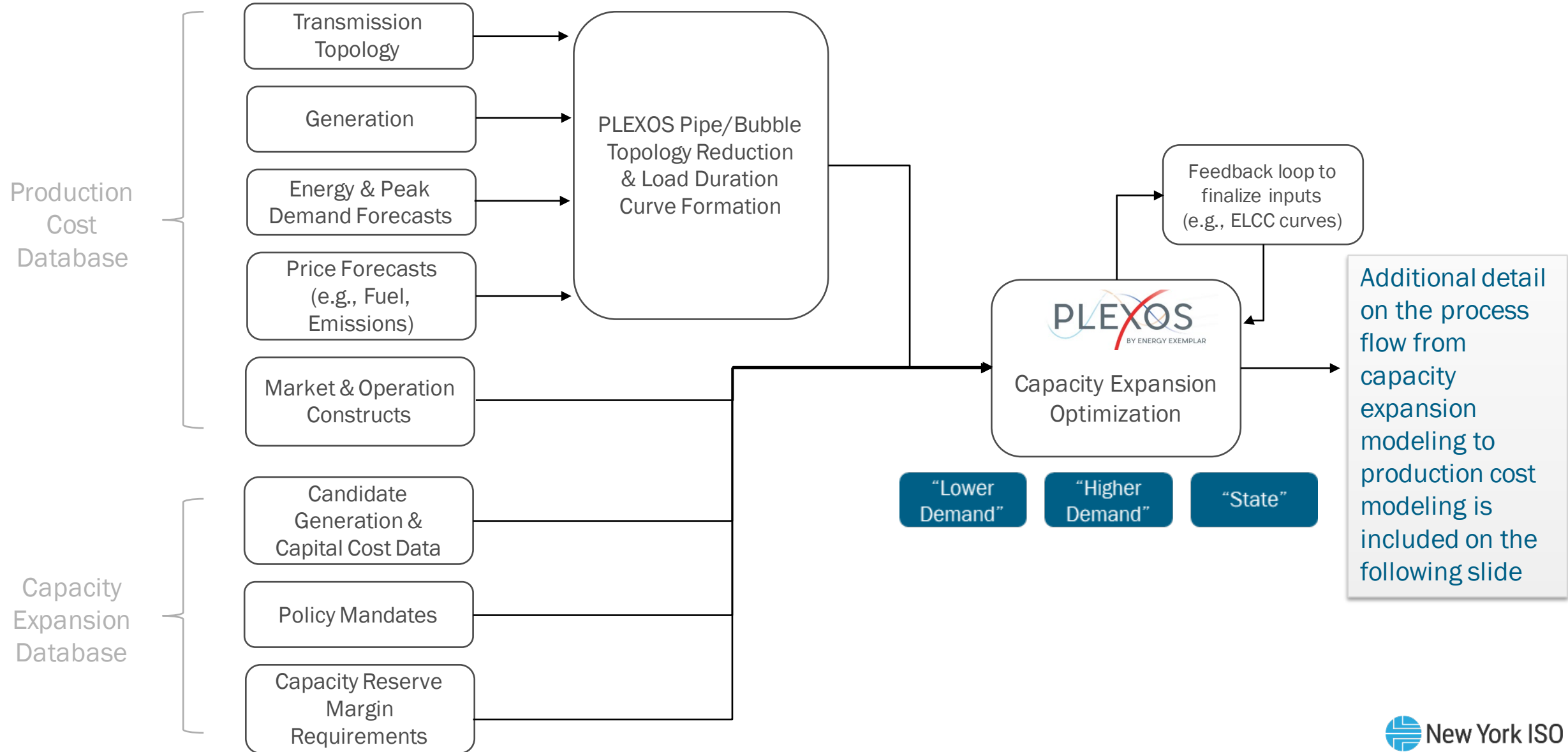
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Stakeholder Presentations

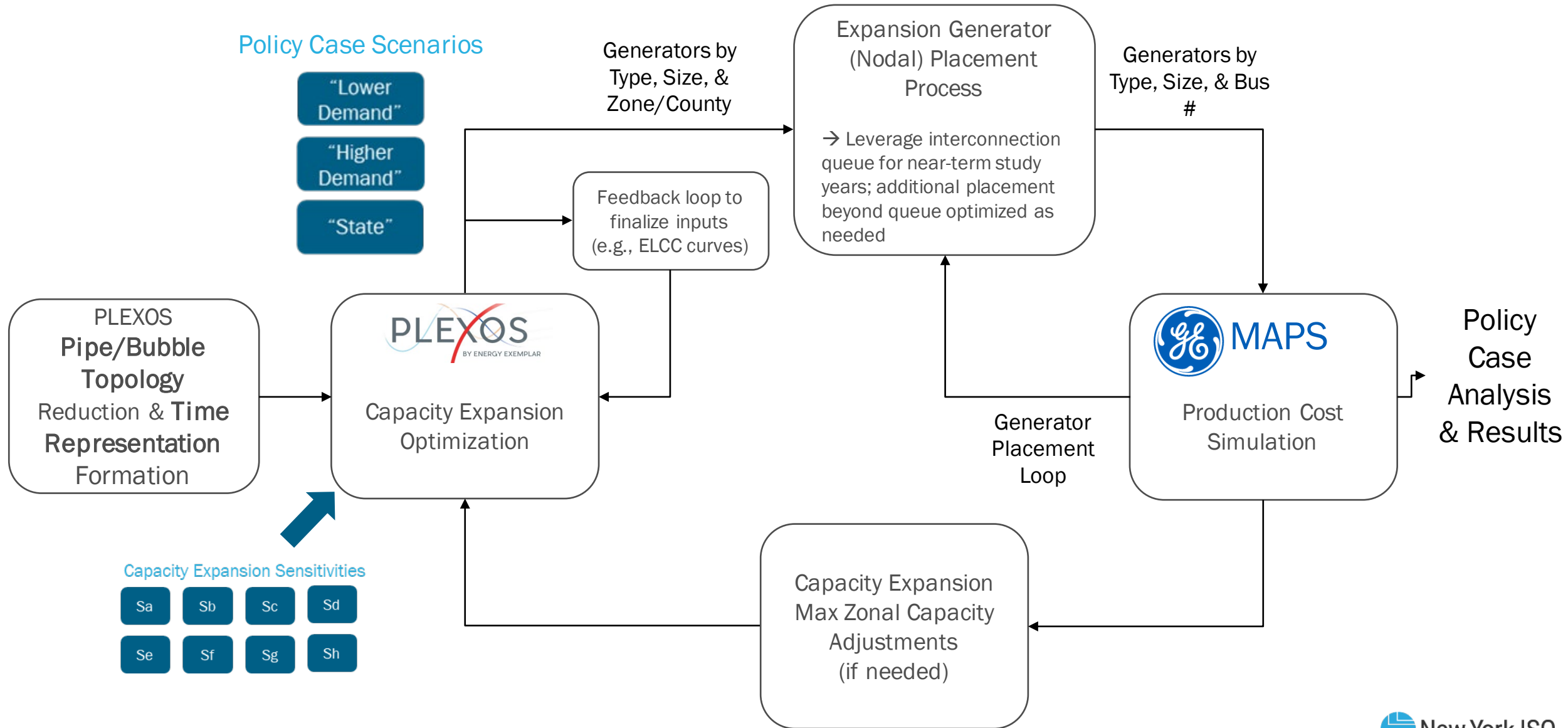
November 18, 2022 2021 Outlook Lessons Learned NYSERDA Outlook Suggestions	December 19, 2023 2023-2042 Outlook Reference Case Updates & Preliminary Contract Case Results
June 16, 2023 2023-2042 Outlook Kickoff	January 23, 2024 2023-2042 Outlook Reference Case Updates
July 17, 2023 2023-2042 Outlook Benchmark 2023-2042 Outlook Update	February 22, 2024 2023-2042 Outlook Reference Case Updates & Final Base & Contract Case Results
August 22, 2023 2023-2042 Outlook Preliminary Reference Case Assumptions	
September 21, 2023 2023-2042 Outlook Reference Case Assumptions Update	
October 24, 2023 2023-2042 Outlook Reference Case Assumptions Update	
November 2, 2023 2023-2042 Outlook Reference Case Assumptions Update & Preliminary Base Case Results	
November 21, 2023 2023-2042 Outlook Reference Case Updates	

Appendix

Policy Case Process Flow



Policy Case Simulation Framework



Our Mission & Vision



Mission

Ensure power system reliability and competitive markets for New York in a clean energy future



Vision

Working together with stakeholders to build the cleanest, most reliable electric system in the nation